



DESCRIPTIONS

Astronaut

Astronauts are men and women with varying backgrounds, many talents and from the United States and any of 14 International Space Station (ISS) partner countries. Russia is also an ISS partner but their astronauts are called *Cosmonauts*. Astronauts are trained as Commanders, Pilots, Mission Specialists, Payload Specialists and Educator Astronauts for flight on the Space Shuttle. Astronauts assigned to the International Space Station are trained as Commanders, Flight Engineers and Science Officers. All Astronauts come from previous experiences in sciences, technology, engineering and mathematics which help them to conduct experiments while on orbit. Each astronaut receives training to perform experiments for the scientists on Earth, including Cellular Biotechnology research.

Bioreactor

Bioreactors are tools used by biotechnology scientists that allow cells to grow by providing oxygen to and removing wastes from the culture medium. At NASA, rotating bioreactors can be used to imitate microgravity conditions by rotating growing cells, including bacteria, in a cylinder of water and nutrients (the culture medium) turned on its side. Rotating this way keeps the cells in a state of free-fall causing the cells to move more freely and gravity to have a random effect. Growing, or *culturing*, cells this way allows them to grow in all three dimensions instead of flat in a dish. Many cell types, diseases, and cancers are being studied using rotating bioreactors to culture cells.

Biotechnology Facility (BTF)

The Biotechnology Facility is a compact collection of scientific instruments and experiments that are designed to use the microgravity environment of low Earth orbit as a tool for basic and applied cell biology research on the ISS. The BTF has instruments that can grow cells in stationary and rotating bioreactors while monitoring their health and status. It also has cold storage at +4°C, -80°C and -180°C (39°F, -176°F and -356°F) and supplies the gases and culture media necessary for cell growth. The BTF's highly automated design minimizes crew time and allows for experiments to be done with minimal interruptions. It will be made to fit in two (2) EXPRESS Racks. EXPRESS Racks (Expedite the Processing of Experiments to Space Station) are standardized payload rack systems for ISS experiments.

Cell

The most basic unit of life, cells are microscopic cities. They are filled with a watery fluid called *protoplasm* and numerous small machines called *organelles* or "little organs." Cells' small size allows for more surface area in relation to their volume. They may be part of larger tissues and organisms or be single-celled beings on their own like bacteria. Cells are divided into two groups: *prokaryotes* and *eukaryotes*. Prokaryotes are the most simple, single-celled organisms and do not have a nucleus bound in a membrane. Most cells however, are eukaryotic such as this human cell.

International Space Station (ISS)

The International Space Station, or ISS, represents a global partnership of 16 nations including: the United States, Russia, Canada, Japan, Brazil, Belgium, Denmark, France, Germany, Italy, the Netherlands, Norway, Spain, Sweden, Switzerland and the United Kingdom. This project is an engineering, scientific and technological marvel ushering in a new era of human space exploration. The million-pound space station will include six laboratories and provide more space for research than any spacecraft ever built. Internal volume of the space station will be roughly equal to the passenger cabin volume of a 747 jumbo jet and the solar panels will give the ISS an area of two football fields side-by-side. The JSC Exploration Cell Science project plans to install the Biotechnology Facility on the ISS for continued cell research.

KC-135

The KC-135 is a modified aircraft used for performing microgravity and low-gravity research. KC-135s are typically used by the military for refueling other aircraft while in flight. At NASA's Johnson Space Center, this four-engine turbojet is used to train astronauts and perform research. The KC-135 achieves microgravity conditions by flying in large arcs, or *parabolas*, accomplishing 20-25 seconds of what appears to be floating. Actually, the contents of the aircraft are free-falling with the jet itself. These intervals are not long enough to grow cells but they are used to test Cellular Biotechnology equipment, or what NASA scientists call *hardware*. A typical mission is 2 to 3 hours long with 30 to 40 parabolas. Going up and down like a roller coaster can create the same effects in a plane as at the amusement park. Therefore, the KC-135 has earned the famous nickname: "The Vomit Comet."

Microscope

In your classroom, you may use a *light microscope*. Light microscopes, also known as optical microscopes, bend light to make images larger using double convex lenses (from the side they look football-shaped). A single lens, or magnifying glass, is a *simple microscope*. Most scientists prefer to use *compound microscopes*, like the one pictured. These use two (2) or more lenses together to enlarge the apparent size of an object. In some sciences, objects being observed have sizes near the wavelength of light. Therefore, scientists use stronger types of microscopes called *electron microscopes*. Electron microscopes use beams of electrons instead of light waves to "see" objects 1-10 Angstroms in size (about 1 billionth of a meter). These microscopes can allow scientists to make images of atoms! Scientists at NASA use several types of these microscopes to examine cell specimens and their parts.

Petri dish

A traditional tool used for growing cells on earth, a Petri dish has a shallow, circular shape and a loose-fitting lid. Petri dishes, such as the one pictured here, sometimes use a liquid media to provide nutrients for mammalian cell culture. Cells grown on earth, such as those in Petri dishes, form to their container in a flat, two-dimensional shape. Although an inexpensive and effective way of culturing cells, Petri dishes do not give the three-dimensional results achieved with NASA's rotating Bioreactor. The Petri dish is named after its inventor, a German bacteria scientist (bacteriologist), Julius Richard Petri (1852-1921).

Scientist

A scientist is a person that learns about and investigates the physical and natural world around him or her using the scientific method. The scientific method has five (5) steps: 1) observe a problem, 2) form a hypothesis, 3) make predictions, 4) conduct experiments and analyze findings and 5) modify the hypothesis until it can explain the results. Scientists use many different tools and methods to gain knowledge and create theories. The JSC Exploration Cell Science project includes many scientists to seek a greater understanding of cell biology. Being a scientist takes years of studying but can lead to a very rewarding career in biology, chemistry, physics or one of many other related sciences.

Shuttle

The Space Shuttle is the world's first reusable spacecraft and the first spacecraft in history that can carry large satellites up to 28,800 kilograms (63,500 pounds) both to and from orbit. It is the only craft used to carry Cellular Biotechnology experiments into orbit to be tested on the Shuttle or on the International Space Station. The Shuttle launches like a rocket, maneuvers in Earth orbit like a spacecraft and lands like an airplane. Missions are most often referred to by the acronym "STS" followed by a number. STS stands for "Space Transportation System" and includes the Shuttle, External Tank (ET) and the two (2) Solid Rocket Boosters (SRBs). The Shuttles are called *Orbiting Vehicles* (OV) and there have been six used by NASA: Challenger (OV-099), Enterprise (OV-101 flight-testing only), Columbia (OV-102), Discovery (OV-103), Atlantis (OV-104) and Endeavour (OV-105). Currently, only Discovery, Atlantis and Endeavour are in use for spaceflight.